What is claimed is:

1. An electrochemical system adapted to operate between a fuel cell mode, an electrolysis mode, and a mode alternating between said electrolysis mode and said fuel cell mode operating on a fuel gas mixture and an oxygen-containing gas mixture, said system comprising:

at least one hollow planar cell arranged to form an electrochemical stack, said stack including an electrical contact structure at each end of said stack, said hollow cell defining a central chamber therein and wherein said cell comprises:

a hollow planar, substantially impervious, electrolyte within each cell;

a hollow planar fuel electrode having an outermost edge and an innermost edge and contacting said electrolyte, said fuel electrode being on one side of the electrolyte;

a hollow planar oxygen electrode contacting said electrolyte on the opposite side of said electrolyte from said fuel electrode and having an outermost edge and an innermost edge;

an electronically conductive tapered fuel diffusion layer contacting said fuel electrode and having an innermost edge, an outermost edge, a planar side and a tapered side, said tapered fuel diffusion layer adapted to allow fuel and oxidized fuel transport via gaseous diffusion between said tapered fuel diffusion layer and said fuel electrode, said tapered fuel diffusion layer having a configuration being progressively thicker from either said innermost edge to said outermost edge or from said outermost edge to said innermost edge;

an electronically conductive tapered oxygen diffusion layer contacting said oxygen electrode and having an innermost edge, an outermost edge, a planar side and a tapered side, said oxygen diffusion layer adapted to allow oxygen transport via gaseous diffusion between said tapered oxygen diffusion layer and said oxygen electrode, said tapered oxygen diffusion layer having a configuration being thicker from either said innermost edge to said outermost edge or from said outermost edge to said innermost edge;

an electronically conductive, substantially impervious, hollow planar separator for separating each cell from an adjacent cell within said stack and electrically connecting each cell to an adjacent cell, said separator being in contact with and disposed between said tapered side of said tapered fuel diffusion layer and said tapered side of said tapered oxygen diffusion layer;

a first annular seal surrounding the outermost side of said fuel electrode and said tapered fuel diffusion layer, thereby preventing said oxygen-containing gas mixture from accessing said fuel electrode and said tapered fuel diffusion layer;

a second annular seal surrounding the innermost side of said oxygen electrode and said tapered oxygen diffusion layer, thereby preventing said fuel gas mixture from accessing said oxygen electrode and said oxygen diffusion layer;

a fuel chamber for providing a fuel source to said system, said fuel chamber able to communicate with said system; and

an air chamber for providing an oxygen source to said system, said air chamber able to communicate with said system,

wherein one of said fuel chamber and said air chamber is provided in said central chamber and the other is provided surrounding said system.

2. The electrochemical system according to claim 1 wherein said tapered fuel diffusion layer is tapered in the opposite direction of said tapered oxygen diffusion layer.

3. An electrochemical system of claim 1 wherein said oxygen-containing gas mixture is substantially pure oxygen.

4. The electrochemical system of claim 1 wherein said at least one cell has a shape selected from the group consisting of circular, square, rectangular and oval.

5. The electrochemical system of claim 1 wherein said fuel gas mixture comprises steam and hydrogen in each of said modes.

6. The electrochemical system of claim 1 wherein said at least one hollow planar cell is defined by at least one cavity.

7. The electrochemical system of claim 1 and further including an additional electrical contact layer applied to at least one side of said separator to improve the electrical contact between the components of said at least one cell.

8. The electrochemical system of claim 7 wherein said additional electrical contact layer is ink comprising finely-divided electrode composition.

9. The electrochemical system of claim 1 wherein said fuel gas mixture flows past each cell substantially in succession thereby performing progressive reaction of said fuel gas mixture and enabling higher conversion efficiency.

10. A solid-oxide fuel cell system adapted to operate on a fuel gas mixture and an oxygen-containing gas mixture, said system comprising:

at least one hollow planar cell arranged to form an electrochemical stack, said stack including an electrical contact structure at each end of said stack, said cell defining a central chamber therein and wherein said cell comprises:

a hollow planar, substantially impervious, electrolyte within each cell;

a hollow planar fuel electrode having an outermost edge and an innermost edge and contacting said electrolyte, said fuel electrode being on one side of the electrolyte;

a hollow planar oxygen electrode contacting said electrolyte on the opposite side of said electrolyte from said fuel electrode and having an outermost edge and an innermost edge;

an electronically conductive tapered fuel diffusion layer contacting said fuel electrode and having an innermost edge, an outermost edge, a planar side and a tapered side, said tapered

fuel diffusion layer adapted to allow fuel and oxidized fuel transport via gaseous diffusion between said tapered fuel diffusion layer and said fuel electrode, said tapered fuel diffusion layer having a configuration being progressively thicker from either said innermost edge to said outermost edge or from said outermost edge to said innermost edge;

an electronically conductive tapered oxygen diffusion layer contacting said oxygen electrode and having an innermost edge, an outermost edge, a planar side and a tapered side, said oxygen diffusion layer adapted to allow oxygen transport via gaseous diffusion between said tapered oxygen diffusion layer and said oxygen electrode, said tapered oxygen diffusion layer having a configuration being thicker from either said innermost edge to said outermost edge or from said outermost edge to said innermost edge;

an electronically conductive, substantially impervious, hollow planar separator for separating each cell from an adjacent cell within said stack and electrically connecting each cell to an adjacent cell, said separator being in contact with and disposed between said tapered side of said tapered fuel diffusion layer and said tapered side of said tapered oxygen diffusion layer;

a first annular seal surrounding the outermost side of said fuel electrode and said tapered fuel diffusion layer, thereby preventing said oxygen-containing gas mixture from accessing said fuel electrode and said tapered fuel diffusion layer; and

a second annular seal surrounding the innermost side of said oxygen electrode and said tapered oxygen diffusion layer, thereby preventing said fuel gas mixture from accessing said oxygen electrode and said oxygen diffusion layer;

a fuel chamber for providing a fuel source to said system, said fuel chamber able to communicate with said system; and

an air chamber for providing an oxygen source to said system, said air chamber able to communicate with said system,

wherein one of said fuel chamber and said air chamber is provided in said central chamber and the other is provided surrounding said system.

11. The electrochemical system according to claim 10 wherein said tapered fuel diffusion layer is tapered in the opposite direction of said tapered oxygen diffusion layer.

12. The fuel cell system of claim 10 wherein said at least one cell has a shape selected from the group consisting of circular, square, rectangular and oval.

13. The fuel cell system of claim 10 further including an additional electrical contact layer applied to at least one side of said separator to improve the electrical contact between the components of said at least one cell.

14. The fuel cell system of claim 13 wherein said additional electrical contact layer is ink comprising finely-divided electrode composition.

15. The fuel cell system of claim 10 wherein said fuel gas mixture flows past each cell substantially in succession thereby performing progressive oxidation of said fuel gas mixture and enabling higher conversion efficiency.

16. A solid-oxide fuel cell system adapted to operate on a fuel gas mixture and an oxygen-containing gas mixture, said system comprising:

at least one hollow planar cell arranged to form an electrochemical stack, said stack including an electrical contact structure at each end of said stack;

a hollow planar, substantially impervious, electrolyte within each cell;

a hollow planar fuel electrode having an outermost edge and an innermost edge and contacting said electrolyte, said fuel electrode being on one side of the electrolyte;

a hollow planar oxygen electrode contacting said electrolyte on the opposite side of said electrolyte from said fuel electrode and having an outermost edge and an innermost edge;

an electronically conductive tapered fuel diffusion layer contacting said fuel electrode and having an innermost edge, an outermost edge, a planar side and a tapered side, said tapered fuel diffusion layer adapted to allow fuel and oxidized fuel transport via gaseous diffusion between said tapered fuel diffusion layer and said fuel electrode, said tapered fuel diffusion layer having a configuration being progressively thicker from either said innermost edge to said outermost edge or from said outermost edge to said innermost edge;

an electronically conductive tapered oxygen diffusion layer contacting said oxygen electrode and having an innermost edge, an outermost edge, a planar side and a tapered side, said oxygen diffusion layer adapted to allow oxygen transport via gaseous diffusion between said tapered oxygen diffusion layer and said oxygen electrode, said tapered oxygen diffusion layer having a configuration being thicker from either said innermost edge to said outermost edge or from said outermost edge to said innermost edge; and

an electronically conductive, substantially impervious, hollow planar separator for separating each cell from an adjacent cell within said stack and electrically connecting each cell to an adjacent cell, said separator being in contact with and disposed between said tapered side of said tapered fuel diffusion layer and said tapered side of said tapered oxygen diffusion layer.

17. The solid-oxide fuel cell system according to claim 16 and further including a first annular seal surrounding the outermost edge of said fuel electrode and said tapered fuel diffusion layer, thereby preventing said oxygen-containing gas mixture from accessing said fuel electrode and said tapered fuel diffusion layer.

18. The solid-oxide fuel cell system according to claim 17 and further including a second annular seal surrounding the innermost edge of said oxygen electrode and said tapered oxygen diffusion layer, thereby preventing said fuel gas mixture from accessing said oxygen electrode and said oxygen diffusion layer.